01-28-00

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Attorney Docket No. 31358-233

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

EL152352867US

In re patent application of: Cree et al.

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For: TEAR RESISTANT ELASTIC LAMINATE AND METHOD OF FORMING

BOX PATENT APPLICATION
To the Honorable Assistant
Commissioner of Patents
Washington, D.C. 20231

Sir:

UTILITY PATENT APPLICATION TRANSMITTAL LETTER
(Non provisional application under 37 C.F.R. §1.53(b))

Transmitted herewith for filing, please find the following:

1. (XX) The specification, claims and abstract comprising 26 pages.
2. (XX) 2 sheet(s) of informal drawing(s).
3. (XX) A Combined Oath and Power of Attorney (unsigned).
4. (XX) This application claims the benefit under Title 35 U.S.C. § 119(e) of U.S. Provisional Application No. 60/151,472 filed August 30, 1999.
5. (XX) The fees for this application have been calculated and are included as shown below:

FEE FOR	UTILITY APPLICATION NO. CLAIM(S)	SMALL ENTITY	OR	LARGE ENTITY	OR	DESIGN APPLICATION SMALL ENTITY	OR	LARGE ENTITY
BASIC FEE		$345	OR	$690.00		$155.00	OR	$310.00
INDEP. CLAIMS	2 - 3 =	___ x 39 = $	OR	___ x 78 = $				
TOTAL CLAIMS	24 - 20 =	___ x 9 = $	OR	4 x 18 = $ 72.00				
MULT DEPEND		+ 135 = $	OR	+ 270 = $				
TOTAL FILING FEES		$	OR	$ 762.00	OR	$ 155.00	OR	$

X A check(s) in the amount of $ 762 is enclosed herewith. Please charge any deficiency or credit any overpayment to Deposit Account No. 10-0447 .

6. (XX) The correspondence address for this application shall be:

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7. (XX) The Commissioner is hereby authorized to charge any fee specifically authorized hereafter, or any missing or insufficient fee(s) filed, or asserted to be filed, or which should have been filed herewith or concerning any paper filed hereafter, and may be required under 37 CFR §1.16-1.18 (missing or insufficiencies only) now or hereafter relative to this application and for the resulting Official Document under 37 CFR 1.20, and to have and cause any necessary petition for extension of time to be filed and any fees necessary to be paid for said extension of time OR credit any overpayment to our Deposit Account No. 10-0447, for which purpose a duplicate copy of this sheet is attached.

8. ( ) Other (specify):____
____.

9. (XX) Confirmation Postcard.

Respectfully submitted,

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

TITLE

TEAR RESISTANT ELASTIC LAMINATE AND METHOD OF FORMING

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CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit under Title 35 United States Code §119(e) of U.S. Provisional Application No. 60/151,472, filed August 30, 1999.

BACKGROUND OF THE INVENTION

Technical Field

This invention relates generally to elastic laminates, and more particularly to a laminate having an elastic polymer film core with at least one layer of an extensible nonwoven web bonded to each side of the elastic polymer film core.

Background Art

There is a recognized need for a tear resistant elastic laminate that has a soft, comfortable outer surface. For example, in personal hygiene products such as diapers, there is a need for an elastic ear that can be stretched to provide a comfortable fit for the different anatomies of various wearers, improve the fit and comfort, reduce leakage, and be compatible with adhesive and mechanical fasteners. To provide the necessary stretching characteristics, the diaper ear must be formed of an elastic material that can stretch and recover without tearing prematurely. Moreover, there is a need to provide a lightweight cloth-like film based laminate that has an elastic recovery from stretching that is comparable to natural or synthetic rubber films in the transverse direction, and has a tear resistance that is comparable to durable cotton or fabrics composed of LYRCA® synthetic fibers or filaments.

Several arrangements have been proposed for tear-resistant elastic laminates. For example, U.S. Patent No. 5,709,921 issued January 20, 1998 to Susan Elaine Shawver, discloses a multi-layer material formed of layers of elastomeric films, fibers, or webs. However, elastomeric materials, when disposed as the outer surface of a laminate, do not provide the softness and comfort characteristics of nonelastomeric outer webs. U.S. Patent No. 5,226,992 issued July 13, 1993 to Michael T. Morman, requires the use of force to pre-tension a necked non-woven prior to laminating to form a composite elastic neck-bonded laminate. This laminate is stretchable in a direction parallel to the direction of constriction or necking. It does not provide strong tear resistance due to the presence of the stressed necked material layer in the laminate. Another patent, also issued to Michael T. Morman, U.S. Patent No. 4,981,474 on January 1, 1991, discloses a composite material having a nonelastic material bonded to an elastic material while the elastic material is in a stretched condition so that when the elastic material is relaxed, the nonelastic material gathers between the locations where it is bonded to the elastic material. The resulting composite elastic material is only stretchable to the extent that the nonelastic material gathered between the bond locations allows the elastic material to elongate. Thus, in this arrangement, the elasticity of the laminate is limited by the inability of the nonelastic material to stretch beyond its initial dimensions. Moreover, the formed laminate is bulky and difficult to process. Another example of an elastic laminated sheet is disclosed in U.S. Patent No. 5,422,172 issued June 6, 1995 to Pai-Chuan Wu, which discloses an elastic laminate formed by stretching, thus compromising the tear resistance of the laminate. U.S. Patent No. 5,354,597 issued October 11, 1994 to Karen M. Capik, et al, discloses an adhesive tape having a multi-layered construction in which at least one of the layers is formed of an

elastomeric material and at least one other layer that is pre-stretched beyond its elastic limit. The tape does not provide the softness or comfort provided by an externally disposed nonwoven web.

The present invention is directed to overcoming the problems set forth above. There is a demonstrated need for a laminate that has the outer softness of a nonelastomeric nonwoven web, the elasticity of an elastomeric film, and the tear resistance of a conventional packaging film. There is also a demonstrated need for such a laminate that is easy to form and economical to produce.

SUMMARY OF THE INVENTION

In accordance with one aspect of the present invention, a tear resistant laminate comprises an elastic polymeric film that has a first nonwoven web formed of nonelastic fibers bonded to a top surface of the elastic polymeric film and a second nonwoven web formed of nonelastic fibers bonded to a bottom surface of the elastic polymeric film. Each of the nonwoven webs has a permanent deformation range from about 20% to about 200%, measured in a predefined transverse direction, and an ultimate force to break of greater than 1,500 g/in. in said predefined transverse direction. The laminate has an elastic elongation value greater than the elastic elongation values of the first and second nonwoven webs, and an ultimate force to break value of at least 3,000 g/in.

Other features of the tear resistant laminate embodying the present invention include the first and second nonwoven webs being formed of randomly disposed nonelastomeric thermoplastic fibers, with at least about 10% of the fibers having approximately equal softening temperatures. Other features include from about 2% to about 50% of the nonelastomeric

thermoplastic fibers being disposed in a skewed direction at an angle greater than about 10 degrees from a predefined machine direction of the respective nonwoven web. Still other features include the nonelastomeric thermoplastic fibers comprising the first and second nonwoven webs having a mass divided by length value of at least about 1.5 denier. Yet additional features include the nonelastomeric thermoplastic fibers being formed of a polyolefin fiber. Desirably, the polyolefin nonwoven web has a basis weight of from about 14 g/m^2 to about 60 g/m^2.

Still additional features of the tear-resistant laminate embodying the present invention include the elastic polymeric film being a metallocene-catalyzed low-density polyethylene film. Yet other features include the metallocene-catalyzed low-density polyethylene film having a basis weight of from about 18 g/m^2 to about 100 g/m^2. Another feature includes the elastic polymeric film having stretch to break properties greater than the stretch to break values of the nonwoven webs. Additional features include the elastic polymeric film being formed of a copolymer blend, for example a block-copolymer blend, a thermoplastic urethane, or a cross-linked rubber film having a basis weight of from about 30 g/m^2 to about 100 g/m^2. Important additional features include the elastic polymeric film being a perforated film.

Yet additional features of the tear-resistant laminate embodying the present invention include the bond between the respective first and second nonwoven webs and the top and bottom surfaces of the polymeric film being a mutually bonded surface area between the respective web surfaces and the film surfaces of at least 3.0% of the respective total surface areas. Still additional features include the first and second nonwoven webs each being separate, multi-layered composite structures formed of two or more layers of nonwoven fabric bonded together.

In accordance with another aspect of the present invention, a method for forming a tear-resistant laminate includes selecting an elastic polymeric film having a basis weight of from about 18 g/m^2 to about 100 g/m^2, selecting a first nonwoven web formed of randomly disposed nonelastomeric thermoplastic fibers, heating the first nonwoven web at a temperature between the softening temperature and the melting temperature of at least 10% of the thermoplastic fibers, drawing the heated first nonwoven web under tension in a substantially longitudinal direction, and cooling the first nonwoven web whereby the first nonwoven web is consolidated laterally and is extensible in a direction transverse to the longitudinal direction. Further steps include selecting a second nonwoven web formed of randomly disposed nonelastomeric thermoplastic fibers, heating the second nonwoven web to a temperature between the softening temperature and the melting temperatures of at least about 10% of the thermoplastic fibers, drawing the heated second nonwoven web under tension in a substantially longitudinal direction to cause the web to be longitudinally elongated, and cooling the second nonwoven web whereby the second nonwoven web is consolidated laterally and is extensible in a direction transverse to the longitudinal direction. The bottom surface of the first nonwoven web is then bonded to the top surface of the elastomeric film and the top surface of the second nonwoven web is bonded to the bottom surface of the elastomeric film by thermal fusion with the addition of an applied pressure to produce mutually bonded surface areas between the respective nonwoven web surfaces and the elastomeric film surfaces of at least 3% of the respective total mutually opposed surface areas.

Other features include the step of bonding the respective nonwoven webs with the elastomeric film being carried out by ultrasonic welding.

Other features of the method of forming a tear-resistant laminate, in accordance with the present invention, include forming the first and second nonwoven webs of two or more separately preformed layers of nonwoven material.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the structure and operation of the present invention may be had by reference to the following detailed description when taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a three-dimensional view of a three-layer tear resistant laminate embodying the present invention;

Fig. 2 is a plan view of a preferred weld bond pattern whereby the multiple layers of the tear resistant laminate embodying the present invention are bonded together;

Fig. 3 is a three-dimensional view of a five-layer tear resistant laminate embodying the present invention; and

Fig. 4 is a flow diagram of a method for forming the tear resistant laminate in accordance with the present invention.

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EXEMPLARY EMBODIMENTS

The term "nonwoven web" as used herein means a fabric formed of randomly laid fibers or filaments to form a web wherein some of the fibers are bonded by fiber-to-fiber fusion, by fiber entanglement, or by thermal bonds such as point bonding.

The term "machine direction", as used herein, means the direction in which precursor webs are formed, which is the longitudinal direction of an uncut web.

The term "transverse direction", as used herein means the cross direction, disposed at 90° to the machine direction, and extends across the width of the initially formed precursor web.

A first preferred embodiment of a tear resistant laminate embodying the present invention is generally indicated by the reference numeral **10** in Fig. 1. The laminate **10** is suitable for use in sanitary products that require a closure system provided by the laminate **10** that is soft to the touch and can stretch in a transverse direction indicated by the arrow **11**. The three-layer laminate **10** illustrated in Fig. 1 has a center ply that is formed of an elastic polymeric film **12** having a top surface **14** and a bottom surface **16**. A top layer comprises a first nonwoven web **18** having a bottom surface **20** that is bonded to the top surface **14** of the elastomeric film **12**. The bottom ply of the laminate **10** comprises a second nonwoven web **22** having a top surface **24** that is bonded to the bottom surface **16** of the elastomeric film **12**.

The elastic polymeric film **12** may be formed of either a metallocene based low density polyethylene (m-LDPE), or a block-copolymer blend that contains styrene/butadiene/styrene (SBS), styrene/ethylene-butylene/styrene (SEBS), ethylene vinyl acetate (EVA), thermoplastic urethane, or cross-linked rubber. Desirably, the elastic polymeric film **12** has a basis weight of from about 18 g/m^2 to about 100 g/m^2. Preferably, an m-LDPE film has a basis weight of about 25 g/m^2, whereas block copolymer films have a basis weight of about 50 g/m^2. Also, it is desirable that the elastic polymeric files have less than 25% set when stretched 50%.

In addition to having good elasticity, it is also desirable that the elastic polymeric film **12** be puncture resistant. For example, if the laminate **10** embodying the present invention is used to form pull tabs, or ears, for diaper products, it is important that the laminate not be easily punctured by long fingernails. Since nonwoven materials generally provide little or no puncture resistance, the elastic polymeric film **12** should have a puncture resistance, as represented by a Dart Impact value, of at least 400 g.

In an exemplary embodiment, a low density polyethylene film (m-LDPE) having a basis weight of 25 g/m^2 was used as the middle layer **12** in a multiple layer laminate. The m-LDPE film was tested and found to have the elastic properties listed below in Table I.

TABLE I

MEASURED PROPERTIES OF ELASTOMERIC FILM

Thickness	1 mil	(25 μm)
Tensile force in transverse direction (per unit of sample width):		
at 25% elongation	181 N/m	(468 g/in)
at 50% elongation	205 N/m	(532 g/in)
at break	611 N/m	(1583 g/in)
Elongation at break		588.5%
Dart impact		750 g

The first and second nonwoven webs **18, 22** are formed of nonelastomeric thermoplastic fibers that have good, uniform but random, filament/fiber distribution. The fiber orientation should be such as to provide a degree of fiber randomization wherein at least some of the random fibers are

disposed at an angle with respect to a machine direction of the web **13** that is equal to or greater than 10°. In the preferred embodiments of the present invention, the nonwoven webs **18, 22** are formed of spunbond nonwoven fibers which have a mass divided by length value of at least about 1.5 denier, and preferably from about 2.0 to about 3.5 denier per filament. The polymer composition of the fibers is desirably a polyolefin, and preferably polypropylene or polyethylene/polypropylene blends or other bicomponent blends having polypropylene as one component of the blend.

In an illustrative exemplary embodiment of the present invention, a spunbond thermoplastic polypropylene nonwoven fabric is used as a precursor web in forming the nonwoven webs **18, 22** of the laminate **10** embodying the present invention, produced by Avgol Nonwoven Industries, Ltd. of Holon, Israel and has the properties listed below in Table II.

TABLE II

MEASURED PROPERTIES OF PRECURSOR NONWOVEN WEB

Basis Weight	25 g/m^2	
Tensile force in transverse direction (per unit of width):		
at 25% elongation	539 N/m	(1396 g/in)
at 50% elongation	785 N/m	(2033 g/in)
at break	843 N/m	(2183 g/in)
Elongation at break		72.5%
fiber thickness (mass divided by length)		2.0 denier

The initial nonwoven fabric, described above in Table II, was then consolidated laterally in accordance with the post-treatment processing of nonwoven webs described in U.S. Patent Re. 35,206 reissued April 16, 1996 to Charles B. Hassenboehler, Jr., et al. and titled *POST-TREATMENT OF NONWOVEN WEBS*. More specifically, in the illustrative embodiment, an initial precursor nonwoven web having a width of 1.37 m (54 in.) was laterally consolidated to a width of 0.84 m (33 in.), resulting in a neck-down ratio (ratio of original width to consolidated width) of about 1.6:1. In forming the first and second nonwoven webs **18, 20** embodying the present invention, it is generally desirable to consolidate the precursor webs by a factor of from at least about 1.3:1 to about 4:1 (original width to consolidated width). As described above, it is desirable that the thermoplastic fibers comprising each of the nonwoven webs are randomly disposed within the web, preferably skewed at an angle greater than about 10° from the machine direction **13**. Preferably, at least about 2% and up to about 50% of the thermoplastic fibers are disposed in the skewed direction. Also, it is desirable that the basis weight of the precursor webs be in a range of from about 14 g/m^2 to about 60 g/m^2 (0.003 lb. per ft.^{2} to 0.012 lb./ft.^{2}).

Importantly, the first and second nonwoven webs **18, 22** have essential properties measured in the transverse direction **11,** after consolidation. The consolidation should be sufficient to provide a nonelastic elongation range in the transverse direction of from about 20% to about 200%, and have an ultimate force to break of greater than 580 N/m (1500 g/in.). The nonwoven webs **18, 22** representing the illustrative example of a preferred embodiment of the present invention were consolidated as described above to a neck-down ratio of about 1.6:1. The consolidated nonwoven web was

then tested and found to have the elongation properties listed below in Table III.

TABLE III
PROPERTIES OF CONSOLIDATED NONWOVEN WEB

Tensile force in transverse direction (per unit of sample width):		
at 25% elongation	29 N/m	(74 g/in)
at 50% elongation	266 N/m	(690 g/in)
at break	666 N/m	(1725 g/in)
Elongation at break		109.8%

After forming, the first and second nonwoven webs **18, 22** were bonded to the elastomeric film **12**. More specifically, as shown in Fig. 1, the bottom surface **20** of the first nonwoven web **18** is bonded to the top surface **14** of the film **12**, and the top surface **24** of the second nonwoven web **22** is bonded to the bottom surface **16** of the elastomeric film **12**. Preferably, the bonding between the respective webs **18, 22** and elastomeric film **12** is carried out simultaneously by the use of ultrasonic or fusion bonding. For this purpose, it is desirable that at least about 10% of the randomly disposed fibers in the first and second webs **18, 22** have approximately equal softening temperatures. The nonwoven webs **18, 22** are thus welded, preferably by a combination of thermal and mechanical energy, to provide a peel force greater than 155 N/m (400 g/in.) of width. To provide the adequate peel force, it has been found that a weld area of at least 3.0% of the total contiguous surface area at each of the layer interfaces should participate in the bonding. A pattern of 1/8 mm diameter weld areas, arranged in a geometric pattern as

illustrated in Fig. 2, is sufficient to provide the required mutual bonding area. With continued reference to Fig. 2, the spacing **28** of the 1/8 mm diameter common bond areas **26** in the transverse direction **11**, in the illustrative example, is 4 mm. The spacing **30** between the 1/8 mm diameter common bond areas **26** in the machine direction **13**, of the illustrative example, is 7 mm. As illustrated in Fig. 2, the 1/8 mm common bond areas **26** are arranged to form a series of open trapezoidal figures using a "zig-zag" pattern. The spaced apart point bonds provided by the arrangement illustrated in Fig. 2 assures that all layers, **12, 18, 22** of the laminate **10** are adequately connected and that any force exerted on any one of the layers **12, 18, 22**, or on the laminate **10** as a whole, is distributed through all of the layers **18, 12, 22**. This arrangement is markedly different than adhesive bonding or extrusion lamination which join only two adjacently disposed layers.

A second exemplary embodiment of the present invention is illustrated in Fig. 3. In this embodiment, a five-layer laminate **31** comprises two external layers of nonwoven web on each side of the centrally disposed elastomeric film **12**. More specifically, a first nonwoven web **32** and a second nonwoven web **34** are bonded to each other and to the elastomeric film **12** on the upper side of the film **12**, and a third nonwoven web **36** and a fourth nonwoven web **38** are bonded to each other and to the bottom surface of the elastomeric film **12**. The two double plies of nonwoven web, **32, 34,** and **36, 38** strengthen the laminate **31** while maintaining a soft external surface of the laminate **31**. In this embodiment, as well as in the earlier described embodiment of the three-layer laminate **10**, it is necessary that at least a portion of the fibers comprising each of the nonwoven webs have a similar softening temperature. In forming the five-layer laminate **31**, all of the plies, i.e., the first nonwoven web **32**, the second nonwoven web **34**, the elastomeric

film **12**, the third nonwoven web **36** and the fourth nonwoven web **38**, may be bonded simultaneously by ultrasonic welding or other point fusion welding methods. Alternatively, if so desired, the first and second nonwoven webs **32, 34** may be prebonded to each other to form a single structure, and the third and fourth nonwoven webs **36, 38** may be prebonded to each other to form a second structure, prior to bonding the thus formed double nonwoven web structures to the elastomeric film **12**. Also, if so desired, the elastomeric film **12** may comprise two or more layers of film having similar, or even different, elasticity properties to provide greater tear resistance and minimize the possibility of catastrophic failure. In this arrangement, the nonwoven webs are respectively bonded to the top and bottom surfaces of the assembled multi-layered elastomeric film **12**.

In accordance with another aspect of the present invention, a method for forming a tear resistant laminate is carried out in accordance with the steps outlined in Fig. 4. The steps include selecting an elastomeric polymeric film **12** having a basis weight of from about 18 g/m^2 to about 100 g/m^2, as represented by block **40**. As noted above, the elastomeric film **12** may comprise multiple layers, if so desired. In the preferred embodiment, the elastic polymeric film **12** is a metallocene based low density polyethylene having a basis weight of from about 18 g/m^2 to about 25 g/m^2. If it is desired to form a breathable web, the elastomeric film **12** may be perforated, such as by hot needle perforation or vacuum perforation, as indicated by block **42**.

First and second precursor nonwoven webs having the properties described above are then selected as represented by blocks **44** and **46**. The first and second precursor webs are then heated to a temperature between the softening temperature and the melting temperature of the thermoplastic fibers comprising the webs, as indicated at blocks **48** and **50**. The heated webs are

then drawn in the machine direction, under tension, to cause the web to be elongated in the machine direction and consolidated laterally in the transverse direction as represented by blocks **52** and **54** in Fig. 4. The first and second webs are then cooled whereby the nonwoven webs **18, 22** are consolidated laterally and have an original precursor width to consolidated width ratio of from about 1.3:1 to about 4:1. The cooling steps for the first and second webs are indicated by blocks **56, 58**. The consolidation process for the first and second webs, represented by blocks **44-58** of Fig. 4, are carried out in accordance with the consolidation process described in the above-referenced U.S. Patent Re. 35,206, with the exception of heat setting the drawn webs.

If, in the above-described alternative exemplary embodiment, the five-layer laminate **31** is formed, the third and fourth nonwoven webs are selected, heated, drawn, and cooled as described above with reference to the first and second nonwoven webs, and as represented by blocks **60-72** of Fig. 4. If desired, the first and third nonwoven webs **18, 36**, and the second and fourth webs, **22, 38**, may be bonded to each other as represented at blocks **74** and **76** prior to final assembly of the laminate **31**. Alternatively, the first, second, third and fourth nonwoven webs **18, 22, 36, 38** may all be simultaneously bonded to the elastomeric film **12**.

The consolidated webs, **18-22**, and if so desired in the alternate embodiment, the additional nonwoven webs, are bonded, as described above, to form a single laminate structure **10, 31**, having an elastic elongation range of up to 200% and an ultimate force to break of greater than 772 N/m (2000 g/in.). The multiple layers of the laminate are joined together by fusion bonds that have a collective area of at least 3.0% of the total contiguous surface area of adjacently disposed layers and a peel strength per unit width of greater than 154 N/m (400 g/in.). If the elastomeric film **12** is a multi-layered film, all

layers of the elastomeric film structure may be simultaneously bonded together during bonding of the laminate structure.

More specifically, the measured elongation characteristics of the exemplary embodiment described above having the elastomeric film **12** and two nonwoven webs **18, 22**, one bonded on each side of the elastomeric film **12**, are listed in Table IV. A two-inch wide sample of the laminate **10**, was assembled in accordance with the above described method and tested using a 3-inch jaw gap and a 20-inch/minute crosshead speed.

TABLE IV
MEASURED PROPERTIES OF THREE-LAYER LAMINATE

Tensile force in transverse direction (per unit of width):	
at 25% elongation	240 N/m (621 g/in.)
at 50% elongation	513 N/m (1328 g/in.)
at break	1575 N/m (4080 g/in.)
Elongation at break	135.6%

In addition to the measured elongation properties listed above in Table IV, an additional sample was slit ½ inch deep across the sample width and then stretched in an attempt to induce a tear. The sample failed before a tear across the width of the sample was initiated. This test clearly demonstrated the excellent tear resistance of the laminate **10, 31** embodying the present invention.

INDUSTRIAL APPLICABILITY

The laminate **10, 31** provided by the present invention provides a lightweight, cloth-like, film-based laminate that has an elastic recovery from stretching that is comparable to natural or synthetic rubber films in the transverse direction and has a tear-resistance that is comparable to durable cotton or a stitched LYRCA® material. The laminate **10, 31** provided by the present invention is particularly useful for use as an elastic diaper ear that can be stretched to accommodate the different anatomies of variously sized wearers, and simultaneously improve the fit and reduce leakage around the perimeter of the diaper as a result of the better fit. The laminate provided by the present invention is also useful for use in other sanitary product applications that require a closure system that is lightweight, has good elasticity, is tear-resistant, and is soft to the touch. If a breathable tear-resistant laminate is desired, the layer of elastomeric film **12**, encapsulated between at least two layers of nonwoven web, may be perforated.

Although the present invention is described in terms of preferred exemplary embodiments, with specific measured values of illustrative components, those skilled in the art will recognize that changes in those components which may result in different measured values, but still be in accordance with the teachings of the present invention, may be made without departing from the spirit of the invention. Such changes are intended to fall within the scope of the following claims. Other aspects, features, and advantages of the present invention may be obtained from a study of this disclosure and the drawings, along with the appended claims.

CLAIMS

WHAT WE CLAIM IS:

1. The tear-resistant laminate, comprising:

an elastic polymeric film having a top surface and a bottom surface;

a first nonwoven web formed of nonelastic thermoplastic fibers and having a predefined machine direction and a predefined transverse direction, said web having an extensible elongation value in a range of from about 20% to about 200% and an ultimate force to break of greater than 1500 g/in. in said transverse direction, a top surface and a bottom surface, said bottom surface of the first nonwoven web being bonded to the top surface of said elastomeric film;

a second nonwoven web formed of nonelastomeric thermoplastic fibers and having predefined machine and transverse directions, a predefined extensible elongation value and an ultimate force to break value in said transverse direction that is substantially equal to said extensible elongation values and said force to break value of the first nonwoven web, a top surface and a bottom surface, said top surface of the second nonwoven web being bonded to the bottom surface of the elastomeric film;

said tear resistant laminate having, in a direction aligned with the transverse direction of the first and second nonwoven webs, an elongation value greater than said extensible elongation values of the first and second webs and an ultimate force to break of at least 3000 g/in.

2. The tear resistant laminate, as set forth in Claim 1, wherein said first and said second nonwoven webs are formed of randomly

deposited nonelastomeric thermoplastic fibers, at least about 10% of said fibers having approximately equal softening temperatures.

3. The tear resistant laminate, as set forth in Claim 2, wherein from about 2% to about 50% of said thermoplastic fibers comprising each of the first and second nonwoven webs are skewed in a direction greater than about 10° from the machine direction of the respective nonwoven web.

4. The tear resistant laminate, as set forth in Claim 2, wherein said thermoplastic fibers comprising the first and second nonwoven webs have a mass divided by length value of at least about 1.5 denier.

5. The tear resistant laminate, as set forth in Claim 1, wherein said first and second nonwoven webs are formed of randomly deposited polyolefin fibers.

6. The tear resistant laminate, as set forth in Claim 5, wherein said polyolefin fibers are spun bond polypropylene fibers and said first and second webs have a basis weight of from about 14 to about 60 g/m^2.

7. The tear resistant laminate, as set forth in Claim 1, wherein said elastic polymeric film is a metallocene-based low density polyethylene film.

8. The tear resistant laminate, as set forth in Claim 7, wherein said metallocene-based low density polyethylene film has a basis weight of from about 18 g/m^2 to about 100 g/m^2.

9. The tear resistant laminate, as set forth in Claim 1, wherein said elastic polymeric film is a block copolymer blend.

10. The tear resistant laminate, as set forth in Claim 9, wherein said elastic polymeric film has a basis weight of from about 30 g/m^2 to about 100 g/m^2.

11. The tear resistant laminate, as set forth in Claim 1, wherein said elastic polymeric film has elastic elongation properties greater than the extensible elongation values of the first and second nonwoven webs and a set of less than 25% when stretched 50%.

12. The tear resistant laminate, as set forth in Claim 1, wherein said elastic polymeric film is perforated.

13. The tear resistant laminate, as set forth in Claim 1, wherein said elastic polymeric film has a Dart Impact value of at least 400 g.

14. The tear resistant laminate, as set forth in Claim 1, wherein the bond between the bottom surface of the first nonwoven web and the top surface of the elastic polymeric film, and the bond between the top surface of the second nonwoven web and the bottom surface of the elastic polymeric film each comprise a mutually bonded surface area between respective contiguous web and film surfaces of at least 3.0% of the total contiguous surface area.

15. The tear resistant laminate, as set forth in Claim 1, wherein said first nonwoven web comprises a composite structure formed of two or more layers of a nonwoven fabric bonded together.

16. The tear resistant laminate, as set forth in Claim 1, wherein said second nonwoven web comprises a composite structure formed of two or more layers of a nonwoven fabric bonded together.

17. The tear resistant laminate, as set forth in Claim 1, wherein said elastic polymeric film comprises a plurality of layers of elastic polymeric film, said top surface of the elastic polymeric film being the top surface of the uppermost layer of the plurality of layers, and said bottom surface of the elastic polymeric film being the bottom surface of the lowermost layer of the plurality of layers.

18. A method for forming a tear resistant laminate, comprising:

(a) selecting an elastic polymeric film having a basis weight of from about 18 g/m^2 to about 100 g/m^2;

(b) selecting a first precursor nonwoven web formed of randomly disposed nonelastomeric thermoplastic fibers and having predefined machine and transverse directions;

(c) heating the first precursor nonwoven web to a temperature between the softening temperature and the melting temperature of at least 10% of the thermoplastic fibers comprising the first precursor nonwoven web;

(d) drawing the heated first precursor nonwoven web under tension in said predefined machine direction to cause the first precursor nonwoven web to be longitudinally elongated in said machine direction and consolidated laterally in said predefined transverse direction, thereby forming a first nonwoven web;

(e) cooling the first nonwoven web whereby the first nonwoven web is consolidated in said transverse direction, and has an extensible elongation value in said transverse direction of from about 20% to about 200% and an ultimate force to break in said transverse direction of greater than about 1500 g/in.;

(f) selecting a second precursor nonwoven web formed of randomly disposed nonelastomeric thermoplastic fibers and having predefined machine and transverse directions;

(g) heating the second precursor nonwoven web to a temperature between the softening temperature and the melting temperature of at least 10% of the thermoplastic fibers comprising the second precursor nonwoven web;

(h) drawing the heated second precursor nonwoven web under tension in said predefined machine direction to cause the second precursor nonwoven web to be longitudinally elongated in said machine direction and consolidated laterally in said predefined transverse direction, thereby forming a second nonwoven web;

(i) cooling the second nonwoven web whereby said second nonwoven web is consolidated in said transverse direction, and has an extensible elongation value in said transverse direction of from about 20% to about 200% and an ultimate force to break in said transverse direction of greater than about 1500 g/in.;

(j) bonding a bottom surface of the first nonwoven web to the top surface of the elastomeric film and simultaneously bonding the top surface of the second nonwoven web to the bottom surface of the elastomeric film.

19. The method for forming a tear resistant laminate, as set forth in Claim 18, where said bonding a bottom surface of the first nonwoven web to the top surface of the elastomeric film and simultaneously bonding the top surface of the second nonwoven web to the bottom surface of the elastomeric film includes bonding the respective webs and the elastomeric film together by thermal fusion with the addition of an applied pressure to produce mutually bonded surface areas between the respective adjacently disposed web and film surfaces comprising at least about 3.0% of the total adjacently disposed surface areas.

20. The method for forming a tear resistant laminate, as set forth in Claim 18, wherein said bonding a bottom surface of the first nonwoven web to the top surface of the elastomeric film and simultaneously bonding the top surface of the second nonwoven web to the bottom surface of elastomeric film includes ultrasonically heating spaced-apart preselected portions of the webs and film to produce mutually bonded surface areas between the respective adjacently disposed web and film surfaces of at least 3.0% of the total adjacently disposed surface areas.

21. The method for forming a tear resistant laminate, as set forth in Claim 18, wherein said selecting an elastic polymeric film includes perforating the elastic polymeric film prior to bonding with the bottom surface of the first nonwoven web and the top surface of the second nonwoven web.

22. The method of forming a tear resistant laminate, as set forth in Claim 18, wherein said method includes selecting at least one precursor nonwoven web formed of randomly disposed nonelastomeric thermoplastic fibers, heating the at least one precursor web to a temperature between the softening temperature and the melting temperature of at least 10% of the fibers comprising the additional nonwoven web, drawing the heated at least one additional web whereby the additional web is elongated longitudinally and consolidated laterally, cooling the at least one additional web thereby forming an additional nonwoven web having a defined elastic elongation value and an ultimate force to break value in the transverse direction substantially equal to said elastic elongation value and ultimate force to break value in the transverse direction of said first and second nonwoven webs, and bonding said at least one additional nonwoven web to one of said first and second webs.

23. The method for forming a tear-resistant laminate, as set forth in Claim 22, wherein said bonding said at least one additional nonwoven web to one of said first and second webs is carried out prior to bonding a bottom surface of the first nonwoven web to the top surface of the elastomeric film and simultaneously bonding the top surface of the second nonwoven web to the bottom surface of the elastomeric film.

24. The method of forming a tear resistant laminate, as set forth in Claim 18, wherein said selecting an elastic polymeric film includes selecting an elastic polymeric film comprised of multiple layers of elastic polymeric film.

ABSTRACT OF THE DISCLOSURE

TEAR RESISTANT ELASTIC LAMINATE AND METHOD OF FORMING

An elastomeric film is bonded between two or more layers of nonwoven webs formed of nonelastomeric thermoplastic fibers. The laminate has, in a predefined transverse direction, an elastic elongation value greater than the predefined elastic elongation value of the nonwoven webs, and an ultimate force to break in the predefined transverse direction of at least 3000 g/in. The laminate advantageously provides a tear resistant, multiple ply, fabric that is soft to the touch as a result of the outwardly disposed nonwoven webs, and has a high elastic modulus. The laminate is particularly useful in applications where closure portions of a product must be stretched to keep the product in place when worn.

FIG-1

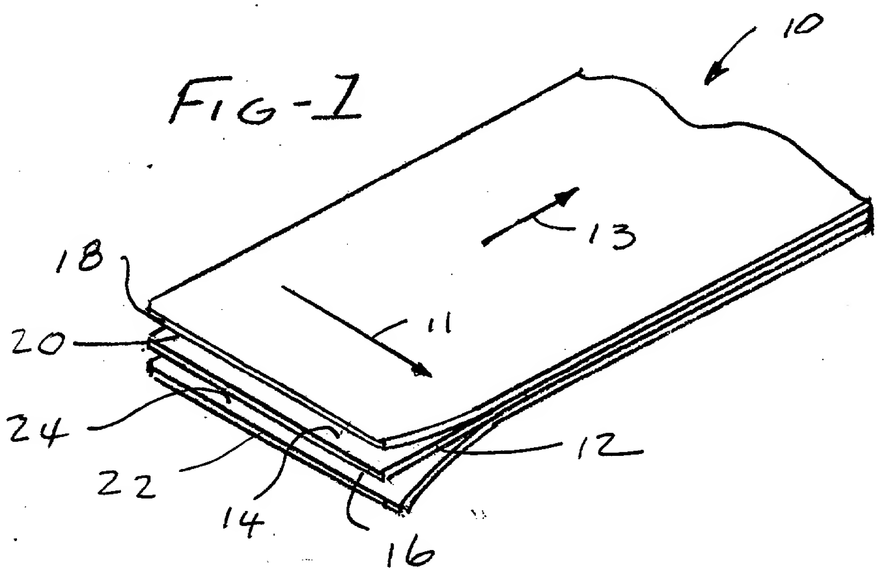


FIG. 2

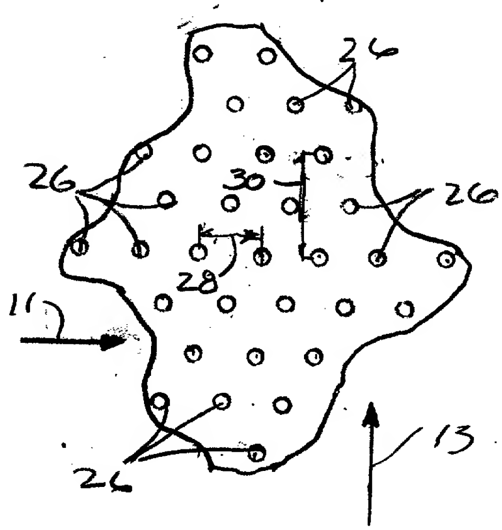


FIG.-3

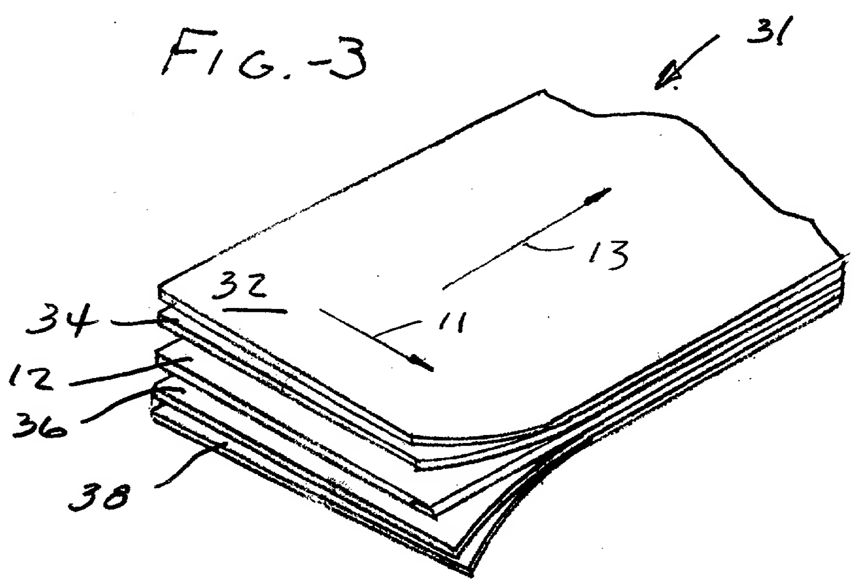
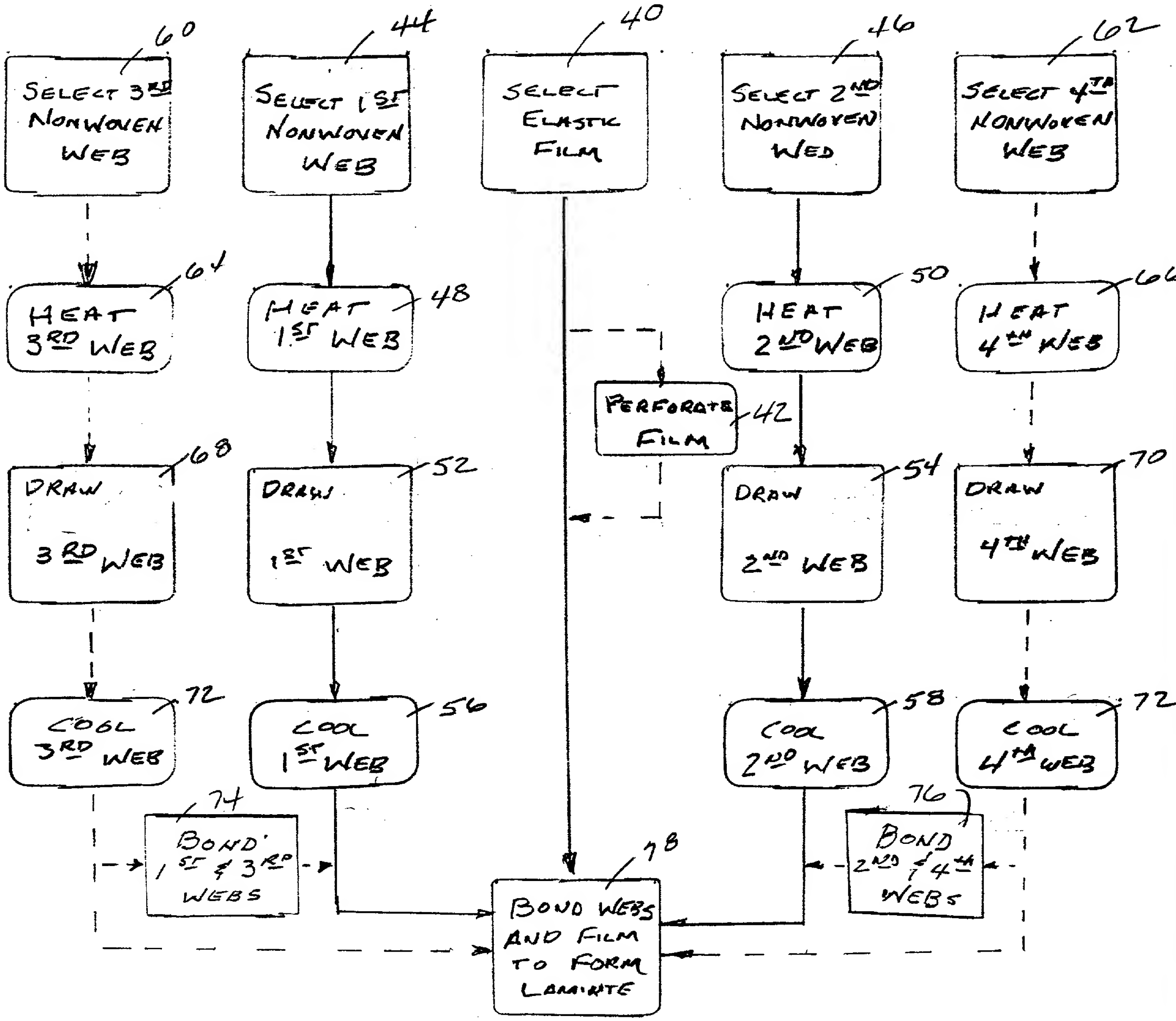


FIG. - 4


SELECT 3RD NONWOVEN WEB
60
SELECT 1ST NONWOVEN WEB
44
SELECT ELASTIC FILM
40
SELECT 2ND NONWOVEN WEB
46
SELECT 4TH NONWOVEN WEB
62
HEAT 3RD WEB
64
HEAT 1ST WEB
48
HEAT 2ND WEB
50
HEAT 4TH WEB
66
PERFORATE FILM
42
DRAW 3RD WEB
68
DRAW 1ST WEB
52
DRAW 2ND WEB
54
DRAW 4TH WEB
70
COOL 3RD WEB
72
COOL 1ST WEB
56
COOL 2ND WEB
58
COOL 4TH WEB
72
BOND 1ST & 3RD WEBS
74
BOND 2ND & 4TH WEBS
76
BOND WEBS AND FILM TO FORM LAMINATE
78

DOCKET NO.: 31358-233 **PATENT**

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; and

I verily believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: TEAR RESISTANT ELASTIC LAMINATE AND METHOD OF OPERATION, the specification of which:

_x_ is attached hereto.
___ was filed on______ as Application Serial No.__________ .

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to the patentability of this application as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate(s), or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application(s) for patent or inventor's certificate(s), or PCT International application having a filing date before that of any application on which priority is claimed:

Country	Number	Date Filed	Priority Claimed

I hereby claim the benefit under 35 U.S.C. § 119(e)(1)-(2) of any United States provisional application(s) listed below:

Application No.	Month/Day/Year Filed	Status (Pending, abnadoned, patented)
60/151472	**August 30, 1999**	**Pending**

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s) listed below, or § 365(c) of any PCT International application designating the United States listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability of the application as defined in 37 CFR § 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.	Filing Date	Status (patented, pending)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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	same as above **Post Office Address**		